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GROWTH RATE AND SURVIVAL PROBABILITY OF BLISTER RUST CANKERS ON SUGAR PINE BRANCHES

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INTRODUCTION

The potential of a white pine blister rust branch canker, caused by *Cronartium ribicola* Fischer, to reach the trunk and kill sugar pine *(Pinus lambertiana* Dougl.*)* saplings and poles has been conjectural. Judgment based on experience has been the only basis for such decisions in the past. Harvey and Cohen *(3)*[1/] established the relationship between the extent of blister rust mycelia in sugar pine bark tissues and canker discoloration to provide guides for pruning infected branches. Since available antibiotics are not effective for eradicating the fungus in sugar pine *(2)* and pruning is not always feasible, the problem of predicting the growth rate and potential threat of a branch canker remains.

In the western white pine region of northern Idaho, quantitative information on the growth rate and survival probability of branch cankers on *Pinus monticola* Dougl. is available *(1, 4, 5)* and is used in disease and damage surveys. Similar information is needed for sugar pine to estimate the threat of branch cankers and to appraise damage.

The present study on sugar pine was made to determine: (a) the proximal[2/] growth rate of cankers, and (b) the survival probability of cankers based on their distance from the trunk.

[1/] Italic numbers in parentheses refer to Literature Cited, p. 6.

[2/] "Proximal" is growth toward trunk as opposed to "distal," growth away from trunk.

METHODS

Five study groups of cankers were established in 1954 at four different localities in southwestern Oregon. The groups included 490 naturally occurring branch cankers on 234 reproduction- or small pole-sized sugar pines. The trees ranged from 4 to 25 feet in height (12.1 feet, average) and from 1 to 8 inches d.b.h. (2.1 inches, average). Three of the groups were located at 2,000- to 3,000-foot elevation, and the remaining two groups were lower (1,650 feet). Selected trees and branch cankers were permanently tagged. The extremities of each canker were marked with a narrow band of light-yellow paint, and the distance from the inner (proximal) margin of the canker to the trunk of the tree was recorded. The plots were reexamined at irregular intervals over 10 full growing seasons to: (a) measure canker growth, and (b) determine which cankers were alive and still enroute to the trunk or had died from suppression or other natural causes. Final examinations were made in 1965.

RESULTS

In 1957, canker growth measurements were terminated, as many cankers were dead or had reached the trunk. Comparison of the average annual proximal growth of cankers on western white pine and sugar pine was made by regression analysis (fig. 1). For both species, the average annual proximal growth of a branch canker increases with increasing branch diameter. Buchanan's data for western white pine in northern Idaho *(1)* show that the average annual proximal growth of western white pine branch cankers is from 1.7 to 1.8 times greater than the growth found for sugar pine cankers of the same diameter in southwestern Oregon. These differences were found to be statistically significant.

The remaining portion of the study was terminated in the spring of 1965. By then, 82 of the original 490 cankers were on trees lost to an earth slide, road construction, right-of-way clearing, and logging. Of the 412 remaining cankers, 146 had reached the trunk, 262 had died from natural causes, and only 4 were still alive and growing toward the trunk (table 1).

By transforming into probits the percentage of cankers reaching the trunk for each original canker-to-trunk-distance class, a mathematically smoothed curve was derived (fig. 2). This curve gives the probability that a sugar pine canker a given distance from the trunk will reach the trunk. Slipp's data from western white pine in northern Idaho *(5)* were adapted for treatment in the same manner so that the two species could be directly compared (fig. 2). The two curves were tested statistically and found to be significantly different.

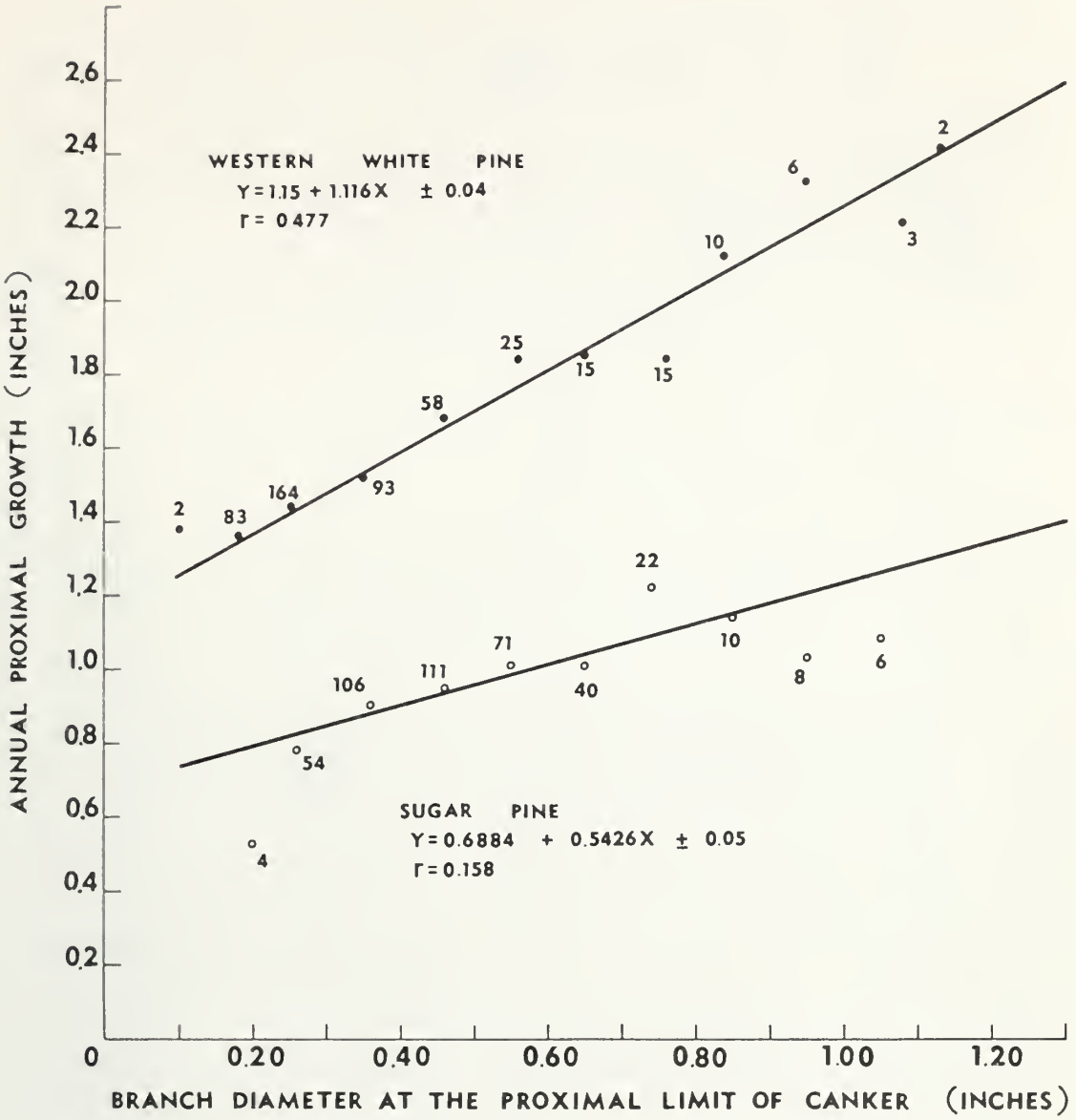

Figure 1.--Comparison of average annual proximal growth of white pine blister rust cankers on branches of western white pine in northern Idaho (data from Buchanan *(1)*) and on branches of sugar pine in southwestern Oregon.

Table 1.--*Number of marked blister rust cankers on sugar pine which had reached trunk, died enroute, or were still enroute to trunk, southwestern Oregon, 1965. Arranged by canker-to-trunk distance in 1954.*

Original canker-to-trunk distances (inches)	Total cankers	Reached trunk by 1965	Died enroute to trunk	Still enroute to trunk in 1965
	Number			
1	19	19	0	0
2	15	14	1	0
3	14	13	1	0
4	27	23	4	0
5	19	16	3	0
6	15	10	5	0
7	14	7	7	0
8	22	10	12	0
9	26	10	16	0
10	13	7	6	0
11	17	2	15	0
12	14	5	9	0
13	16	4	12	0
14	20	1	19	0
15	15	0	15	0
16	11	2	9	0
17	14	2	12	0
18	9	1	8	0
19	5	0	5	0
20	6	0	6	0
21	12	0	11	1
22	9	0	8	1
23	8	0	8	0
24	8	0	7	1
> 24	64	0	63	1
Totals	412	146	262	4

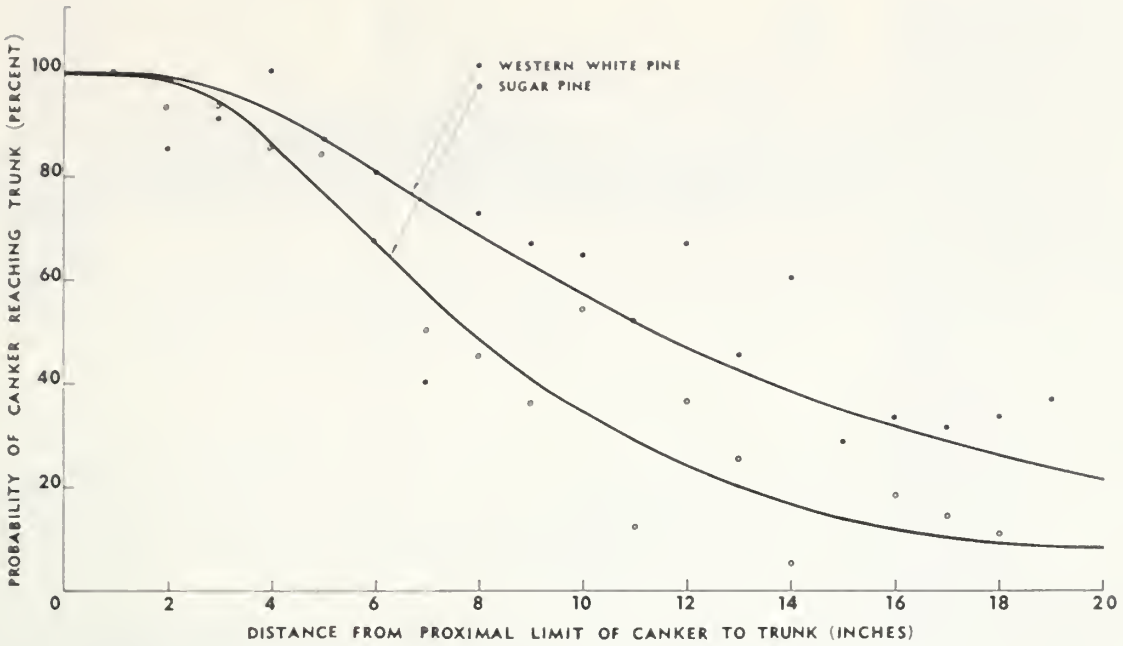

Figure 2.--Probability of white pine blister rust canker reaching trunk in relation to distance from proximal limit of canker to trunk. Comparison of western white pine in northern Idaho (data from Slipp *(5)*) and sugar pine in southwestern Oregon.

CONCLUSIONS

Blister rust branch cankers grow significantly slower on young sugar pine in southwestern Oregon than on young western white pine in northern Idaho. In addition, the probability that a blister rust branch canker on sugar pine in southwestern Oregon will reach the trunk is significantly lower than for a comparable canker on western white pine in northern Idaho. The reasons for these differences are not clear. Perhaps the slower canker growth rate on sugar pine may provide a partial answer to the difference in the canker survival probability rates--a slower growing canker has a longer period of time in which to succumb to branch suppression or other biologic factors.

Figures 1 and 2 provide a means for estimating the time required for a sugar pine branch canker to reach the bole and an estimate of the probability of this occurrence. By determining the distance from the bole to the proximal edge of the canker, it is possible to estimate the potential threat of an existing blister rust canker on sugar pine in southwestern Oregon.

LITERATURE CITED

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